

CONFIDENTIAL

TIRC Grant #93

Dr. Richard L. Wechsler
Montefiore Hospital Institute of Research

Progress Report #1

February 16, 1956

"The Effects of Cigarette Smoking on the Human Brain and Cardiovascular System"

We have completed five successful studies of the cerebral and cardiovascular effects of cigarette smoking and expect to accomplish further work. Therefore, we would appreciate any suggestions.

The cerebral effects of smoking tobacco have been described by many men. Some of these descriptions have stated that tobacco has a quieting and relaxing effect and some have stated it has a stimulating effect. However, few objective studies of these cerebral effects have been reported.

Methods

Paid subjects were chosen at random from the student population. They were young men varying in age from 17 to 23 years. Four were smokers (1 to 1 1/2 package per day) and one did not smoke. A 12 hour period of abstinence from smoking was required in all cases. Studies were accomplished in the morning, with the subjects in a fasting state in the supine position.

After the introduction of the needles and the application of the electrocardiographic and electroencephalographic leads, a 30 minute rest period was observed. Following this period, control observations were made. The subject was then instructed to smoke 3 consecutive cigarettes within 30 minutes. Four-fifths of each cigarette was consumed in 8 to 10 minutes. Only one brand of a normal length cigarette was used in an attempt to keep this factor constant. After finishing the last cigarette, experimental studies were accomplished. Electrocardiograms (lead II), electroencephalograms, and intra-arterial pulse pressure wave recordings were made at frequent (2 to 4 minute) intervals before, during and after smoking. Cerebral blood flows (1), arterial and cerebral blood gases (2) and pH (3) were measured before and from 1 to 10 minutes after finishing the third cigarette. Cerebral metabolism and cerebral vascular resistance were calculated as previously described (1). Arterial and cerebral venous pCO_2 were calculated by means of the nomogram of Peters and Van Slyke (2). Arterial O_2 capacity and saturation were determined (4).

Results and Discussion (See Table I)

Since we only have data on 5 cases at this time, a statistical analysis was not considered advisable. Certain trends are present. The variation in the changes of cerebral blood flow and cerebral metabolism

100353244

indicates that there will be no significant change in these measurements. There is a consistent but small increase in pulse rate but not in blood pressure. Our continuous recordings of electrocardiograms and pulse pressure curves have not yet been analyzed. There were no other consistent changes noted in the parameters studied including cerebral arterio-venous oxygen difference, cerebral vascular resistance, cerebral respiratory quotient, mean arterial blood pressure, hemoglobin, arterial O_2 capacity, O_2 saturation, arterial and internal jugular O_2 , CO_2 , pH and pCO_2 .

In every case intermittent flattening appeared on the electroencephalographic records (Figure I). This flattening occurred only during smoking of cigarettes and lasted from 1 to 30 seconds. This flattening may be an abnormal attention response. Further analysis of the continuous electroencephalographic records by Dr. Chaskiel Grossman should clarify this problem.

Summary

In five normal young men the effects of smoking 3 normal sized cigarettes in 30 minutes were studied. Cerebral blood flows, cerebral metabolism, blood gases, blood pH, electrocardiograms, arterial pulse pressure curves, and electroencephalograms were accomplished before, during, and after smoking. Besides a consistent increase in the pulse rate and the consistent presence of intermittent flattening of the electroencephalographic recordings, no significant changes were noted.

References

1. Kety, S. S. and Schmidt, C. F. The Nitrous Oxide Method for the Quantitative Determination of Cerebral Blood Flow in Man; Theory, Procedure and Normal Values. *J. Clin. Invest.*, 1948, 27, 476.
2. Peters, J. P. and Van Slyke, D. D. Quantitative Clinical Chemistry, Vol. II, Methods, Williams and Wilkins, Baltimore, 1932.
3. Rosenthal, T. B. Effects of Temperature on pH of Blood and Plasma *Vitro*. *J. Biol. Chem.*, 1938, 126, 655.
4. Comroe, J. H., Jr. Methods in Medical Research, Vol. 2, p. 142, Year Book Publishers, Inc., Chicago, 1950.

1003537245

Table I a

Sub- ject	Age	Remarks	Time 3rd cig to 2nd CBF	CBF		CMR O_2		Vols. % (A-V) O_2		CVR		CRQ	
				B	A	B	A	B	A	B	A	B	A
BY	20	Smokes about 1½ pack/day	10	94	54	5.9	3.0	6.3	5.6	0.9	1.6	1.06	1.00
CY	23	Smoke at least 1 pack/day	2	50	63	3.4	4.0	6.7	6.4	1.7	1.5	1.06	1.00
JB	19	Smoke at least 1 pack/day	6	52	61	3.7	4.4	7.2	7.2	1.5	1.4	0.97	0.97
JH	20	Used to smoke not for 2 yrs did not in- hale	8	.72	40	3.9	3.2	5.5	8.1	1.2	2.2	1.00	1.00
MR	17	Smoke 1½ pack per day	1	72	72	3.8	3.9	5.3	5.4	1.2	1.2	1.00	1.02
Mean				68	58	4.1	3.7	6.2	6.5	1.3	1.6	1.02	1.00

Key - CBF--Cerebral Blood Flow

CMR O_2 --Cerebral Metabolic Rate (oxygen consumption)

CVR--Cerebral Vascular Resistance

CRQ--Cerebral Respiratory Quotient

A--After Smoking

B--Before Smoking

1003537246

Table I b

Sub- ject	O ₂ Content				Vols. %		O ₂ Cap. Vols. %	O ₂ Sat. %		Pulse/min.		(mm. Hg.) MABP		Hb. gms/100 cc		CO ₂ Content				Vols. %		
	Arterial		B	A	B	A		B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
BY	19.8	18.3	13.5	12.7	20.1	18.6	100	100	80	80	81	85	14.9	14.9	45.9	46.4	52.6	52.0				
CY	19.2	19.7	12.5	13.3	20.5	21.4	95	93	60	75	83	95	15.4	15.9	46.5	47.8	53.6	54.2				
JB	19.5	19.5	12.3	12.3	20.5	20.6	97	96	72	80	80	85	15.1	15.1	45.5	45.5	52.5	52.5				
JH	19.5	19.7	14.0	11.6	21.5	20.9	92	95	84	96	88	87	15.3	15.3	47.6	44.9	53.1	53.0				
MR	17.9	18.2	12.6	12.6	19.0	19.7	96	94	74	90	91	88	14.5	14.9	49.2	49.2	54.5	54.7				
Mean	19.2	19.1	13.0	12.5	20.3	20.2	95	96	74	84	85	88	15.0	15.2	46.9	46.8	53.3	53.3				

B=before exercise
 A=after exercise
 V=venous
 R=capillary
 C=central
 Arterial
 B=before exercise
 A=after exercise

1003537247

Table I c

Sub- ject	pH				pCO ₂ mm. Hg				EEG
	Arterial		Venous		B	A	B	A	
BY	-	-	-	-	-	-	-	-	Intermittent flattening lasts 4 to 30 seconds, flattening duration decreased as smoking continued. Started 3 minutes after first cigarette started. Flattening stopped within 3 to 12 seconds after cigarette.
CY	7.40	7.41	7.36	7.37	40	40	50	50	Intermittent flattening lasts 3 to 15 seconds. Started 25 seconds after first cigarette started. Flattening continued for 10 minutes after last cigarette.
JB	7.42	7.42	7.38	7.38	38	38	48	48	Intermittent flattening lasts 5 to 10 seconds. Started 1 min. after starting first cigarette. Flattening stopped within 30 seconds of last cigarette.
JH	7.38	7.41	7.31	7.35	43	38	56	51	Intermittent flattening lasts 1 to 3 seconds, starting 4 minutes after starting first cigarette. No inhaling.
MR	7.42	7.40	7.37	7.37	40	42	50	50	Intermittent flattening lasts 5 seconds. Started over a minute after start of first cigarette. 8/second alpha control and 9/second during smoking.

Mean 7.40 7.41 7.35 7.37 40 39 51 50

1003537548